

Feeling the heat

An investors' guide to
measuring business
risk from carbon and
energy regulation

Financial data

| | UK £ | Day % | Mth % | YTD % | Gross Div Yield |
|--------------|--------|-------|-------|-------|-----------------|
| stocks index | 429.5 | 1.3 | 16.9 | -3.8 | 53% |
| 184 | 429.5 | 1.1 | 17.0 | -3.2 | 528.4 |
| 121 | 429.5 | 2.6 | 16.2 | -5.2 | 537.0 |
| 8 | 429.5 | 3.4 | 7.5 | -19.1 | 424.0 |
| 09 | 507.39 | 2.9 | 12.7 | -10.3 | |
| 1 | 495.49 | 3.2 | 7.5 | | |
| 09 | 158.97 | 4.6 | | | |
| 1119.13 | | | | | |
| 20.14 | | | | | |

21

Investment Leaders Group

The Investment Leaders Group (ILG) is a global network of pension funds, insurers and asset managers committed to advancing the practice of responsible investment. It is a voluntary initiative, driven by its members, facilitated by the Cambridge Institute for Sustainability Leadership (CISL), and supported by academics in the University of Cambridge.

The ILG's mission is to help shift the investment chain towards responsible, long-term value creation, such that economic, social and environmental sustainability are delivered as an outcome of the investment management process as investors go about generating robust, long-term returns.

Cambridge Institute for Sustainability Leadership

For 800 years, the University of Cambridge has fostered leadership, ideas and innovations that have benefited and transformed societies. The University now has a critical role to play to help the world respond to a singular challenge: how to provide for as many as nine billion people by 2050 within a finite envelope of land, water and natural resources, whilst adapting to a warmer, less predictable climate.

The University of Cambridge Institute for Sustainability Leadership (CISL) empowers business and policy leaders to tackle critical global challenges. By bringing together multidisciplinary researchers with influential business and policy practitioners across the globe, it fosters an exchange of ideas across traditional boundaries to generate new, solutions-oriented thinking.

Rewiring the Economy

Rewiring the Economy is CISL's ten-year plan to lay the foundations for a sustainable economy. The plan is built on ten interdependent tasks, delivered by government, finance and business co-operatively over the next decade to create an economy that encourages sustainable business practices and delivers positive outcomes for people and societies.

Publication details

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Foreword

Andreas Utermann

CEO & Global Chief Investment Officer,
Allianz Global Investors

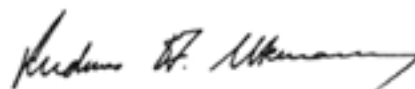
As a global consensus on climate change emerges, it is realistic for investors to consider the effect that carbon and energy regulation may have on businesses' performance.

Prudent investors would do well to understand this risk when considering the sustainability of future earnings and the business models of the companies in which they invest. However, a gap exists in the available analysis since much of it has focused on the macro level – in other words on the interplay between corporations, policy, regulation and market forces. Analysis of the impact of these factors on individual companies and their operations remained limited so far.

Spurred on by commitments made at the recent COP 21 climate talks in Paris, the Investment Leader's Group (ILG) has developed a model which analyses the impact of carbon and energy regulation on industries and more specifically, companies, at a national level. After all, climate change and many of the companies affected by it are global, yet regulation is local.

Adding to the investor's toolbox, the model helps to provide 'context' for investors as the world transitions to a low-carbon society. For instance, it can shed light on a company's exposure to regulation, the possible impact on its profitability and ways in which it might shape its capital spending to secure its future competitiveness, for example, by deploying climate compatible technologies. The report also provides clarity on what data investors need to further improve the quality of their analysis. Despite a growing body of research on the cost to their business, most companies still provide only patchy disclosures on how climate change might impact them.

Building the model has provided us with invaluable insight into the challenges – and opportunities – of valuing the impact of climate-related regulation on companies. This is of course only one facet of how climate change may impact our investments. We hope that our experience in building the model adds to the body of work that helps deepen investor's understanding on future climate change risks.



Investment Leaders Group (ILG) members 2016



Contents

| | |
|--|-----------|
| Executive summary | 3 |
| Part 1. Setting out the challenge | 6 |
| 1.1 The growing impact of carbon and energy regulation | 6 |
| 1.2 Investors' responses to climate-related regulation | 8 |
| 1.3 Developing a bottom-up carbon and energy regulatory risk model | 9 |
| Part 2. The model explained | 10 |
| 2.1 Model characteristics | 10 |
| 2.2 Model building blocks | 12 |
| Part 3. Results and implications | 13 |
| 3.1 Modelling results | 13 |
| 3.2 Limitations | 15 |
| Part 4. Next steps | 16 |
| Glossary | 17 |
| Annex 1: Model building blocks | 18 |
| The regulations | 18 |
| The scenarios | 18 |
| Margin impact calculation | 19 |
| Production technology configuration and risk mitigation measures | 19 |
| Sector-specific assumptions | 20 |
| Avoiding impact double-counting | 21 |
| Annex 2: Utilities – no passthrough | 22 |
| Annex 3: Validation | 23 |
| Annex 4: Non-regulatory energy costs applied | 24 |
| References and notes | 25 |
| Consolidating three years of leadership | 27 |

This report is part of a series of related outputs on responsible investment published by the ILG and CISL:



The moral, financial and economic justification for responsible investment, and the academic evidence underpinning future action.



Analysis of the short-term risks stemming from how investors react to climate-related information.



Guidance on the characteristics of mandates that encourage long-term, sustainable investment management.



Assessment of the impact of carbon-related regulation on asset profitability.



A framework to help investors measure and communicate their contribution to sustainable development.

Executive summary

Investors increasingly recognise that regulation designed to address climate change – aimed at both carbon emissions and energy use – is impacting corporate performance. The EU's 2030 climate and energy targets, the introduction of a national carbon market in China, and the emergence of the US Clean Power Plan are just three examples that are likely to have significant economic effects.

Understanding regulatory effects at the individual company level poses challenges for investors. While some investor groups have been encouraging corporate disclosure of climate risks, and while 'top-down', macro-economic research on the likely impacts of climate change is becoming available to support financial asset allocation, there has been a lack of 'bottom-up', company-level tools that could support improved stock picking.

In response, the Investment Leaders Group (ILG), convened by the Cambridge Institute for Sustainability Leadership (CISL), has contributed to the development of a methodology to model the impact of carbon- and energy-regulation scenarios on firm-level profitability.

Previously, a pilot led by Allianz Global Investors, Allianz Climate Solutions, WWF Germany and The CO-Firm developed the model to examine the impacts on the dairy and cement industries in Germany, California, and Guangdong Province, China. It demonstrated that the financial risk can be substantial. The ILG subsequently extended the pilot to three other energy-intensive sectors and tested its applicability across multiple investment approaches.

This extended project focused on the electric utility, oil refining and gas production sectors in Canada (Alberta), Spain and the United Kingdom. The oil and gas sector analysis was also extended to two of the geographies covered in the pilot, Germany and California.

The model evaluates the impacts on individual company profitability, at the national level, of carbon and energy regulations under two scenarios for 2020. The first – the 'Transition Scenario' – takes as a starting point existing policies and regulations, and examines the financial impact on company profitability of plausible changes to regulations that would come into effect by 2020. The second – the '€45 Carbon Price Scenario' – in addition models the impact of a carbon price of €45/tonne of carbon dioxide (tCO₂), as a proxy for more aggressive policy action to curb emissions. The model also examines the potential for each company to mitigate some of the regulatory impacts, and the effects of such mitigation on its profitability.

The results

The results, the financial impact of carbon regulation on company margin, reveal significant effects of climate and energy regulation on company profitability at a national level.¹ Even more importantly, they highlight significant differences between individual companies in the same sectors and geographies – especially once their response potential is included. This underscores the importance of granular, bottom-up analytics for those trying to understand firm-level risks. For impact at a sector level, see Figure 1.

Utilities

The impact of regulation on utilities can clearly be both positive and negative, depending on the utilities' fuel mix. Under the Transition Scenario, the impact on profitability in Canada (Alberta) is a loss of three per cent or -0.1 EUR cent per kWh, while in Spain, an 84 per cent increase in profitability, of 1.9 EUR ct. per kWh (cents per kilowatt-hour) is estimated.² This difference in impact across companies can also be significant within a single country, ranging from reducing the margin by 74 per cent to increasing it by nearly 300 per cent in Spain, for example.

Executive summary *continued*

Oil refiners

While impact is negligible in the Transition Scenario, under the €45 Carbon Price Scenario the loss in profitability ranges from 1.4 EUR per bbl (barrel) crude oil in California to 1.2 EUR per bbl crude oil in the UK and Germany. These translate to losses of up to 15 per cent of current margins in the UK and Germany. Defining factors in the impact are the configuration of each plant in the fleet and their respective efficiencies as well as the crude oil quality.









Gas production

Under the €45 Carbon Price Scenario, the loss in profitability reaches 5.5 EUR per km³ (1000 cubic meters) natural gas in the US and 4.2 EUR in Canada, representing a potential loss of 11 per cent and 14 per cent of the margin, respectively. For the other countries, the impact is limited or non-existent, such as in Spain, for example, where gas production operations are too small to be covered under the European Union Emissions Trading System (EU ETS).

Risk mitigation

Companies can act to mitigate these impacts. For example, oil refiners can reduce the potential loss of profitability by approximately one third by implementing technical improvements. For electric utilities, mitigation activities – primarily increasing the share of renewables and passing costs through to consumers – can increase margins by approximately 40 per cent versus pre-2020-regulation levels in the UK and Spain in the Transition Scenario.

Figure 1: Impact at a sector level across five countries

| | |  |  |  |  |  |
|--|----------------------------|---|---|--|---|---|
| Oil refining  | Transition Scenario | -0.2 EUR/bbl -3% | -0.1 EUR/bbl -1% | 0.0 EUR/bbl 0% | -0.1 EUR/bbl 1% | 0.0 EUR/bbl 0% |
| | €45 carbon price | -1.2 EUR/bbl -15% | -1.1 EUR/bbl -12% | -1.4 EUR/bbl -11% | -1.2 EUR/bbl -15% | -1.4 EUR/bbl -6% |
| Gas production  | Transition Scenario | -0.6 EUR/kqm gas 0% | 0.0 EUR/kqm gas 0% | 0.0 EUR/kqm gas 0% | -0.4 EUR/kqm gas 0% | 0.0 EUR/kqm gas 0% |
| | €45 carbon price | -4.7 EUR/kqm gas -4% | 0.0 EUR/kqm gas 0% | -4.2 EUR/kqm gas -11% | -3.7 EUR/kqm gas -3% | -5.5 EUR/kqm gas -14% |
| Electric utilities  | Transition Scenario | -3.5 EUR ct./kWh -167% | +1.9 EUR ct./kWh +76% | -0.1 EUR ct./kWh -3% | | |
| | €45 carbon price | +0.2 EUR ct./kWh +10% | +1.6 EUR ct./kWh +64% | -2.5 EUR ct./kWh -64% | | |

Unique model features

The model is unique in that it provides complementary insights that go beyond traditional valuation models and carbon footprinting. Carbon footprinting, which involves the calculation of emissions at a point in time associated with a portfolio of assets, does little to provide an understanding of how emissions arise from a company's business activity and whether and how they can be managed. Alone, it does not enable investors to calculate the associated financial risk in the case of regulation targeting its reduction, as well as any risk mitigation measures available to the company.

The key characteristics of the model are that it:

- **Captures energy- as well as carbon-related regulation**, as governments have the ability to use mechanisms beyond carbon pricing to introduce climate-positive changes in the real economy.
- **Defines two regulatory scenarios for 2020**, allowing for the straightforward interpretation, communication and validation of results.
- **Is dynamic** in that it captures an individual company's potential for mitigating regulatory risk. It thus provides a risk assessment arising from the chosen regulatory scenario before and after any corporate action.

Model limitations

The model intentionally does not capture the entire operational footprint of the companies under analysis, as this stage of the analysis was limited to five countries. The model only takes account of carbon emissions from direct operations and ignores emissions arising along the supply chain or those arising out of the use of products or services. Data availability continues to remain challenging and is reflected in the accuracy of results.

Implications and next steps

Further development and refinement of the tool is required but, once complete, it is envisaged that it could be used to complement bottom-up financial analysis. Equally, given the company-level insights the model provides, it has the potential to be used as an engagement tool, as it provides insights as to the extent to which company climate change commitments can be realistically translated into action. It also has the potential to be used for portfolio-level stress testing, once it has been applied to a sufficient number of portfolio companies.

Important directions for further research include modelling to cover the full operational footprint of the companies analysed. In the future, the model can also be expanded to other high-risk sectors, such as chemicals and transportation. We invite other investment firms, especially those with in-house financial analysis expertise, to become involved. Given the key role that sell-side institutions play in the industry's understanding of company value, we encourage them to participate too.

The model is unique in that it provides complementary insights that go beyond traditional valuation models and carbon footprinting.

Part 1

Setting out the challenge

1.1 The growing impact of carbon and energy regulation

The breakthrough climate agreement forged in Paris in December 2015 represents the latest high-water mark in more than two decades of rising concern about climate change.

That concern is driven by a scientific consensus – that the world needs to dramatically reduce greenhouse gas (GHG) to limit global warming – which has become overwhelming.

The latest assessment of climate science produced by the Intergovernmental Panel on Climate Change (IPCC) suggested a 41-72 per cent reduction in global emissions will be needed by 2050 to provide a greater than 66 per cent chance of holding the global average temperature rise to below 2°C above pre-industrial temperatures by the end of this century.³ This implies a full decarbonisation of the energy sector by 2050 and net zero emissions between 2060 and 2080.

To achieve such reductions, a combination of disruptive low-carbon technologies and increasingly stringent policies and regulations will be needed. These policies will either mandate certain behaviour or, by using taxation and subsidies, increase the cost of activities that produce GHGs and reduce the cost of those with lower carbon emissions.

Governments have been introducing such policies since the 1990s but, as the scientific case for action on climate change has become stronger, climate policy formation is accelerating. As the successor to the 1997 Kyoto Protocol, the Paris Agreement is the first universal, legally binding international climate pact. Assuming it enters into force, it will commit all 195 UN member countries to hold temperature rises to “well below 2°C”, with a more ambitious aspiration to limit global warming to 1.5°C.⁴

The Paris Agreement is based upon national climate change plans, submitted by governments ahead of the Paris talks. These set out each country’s emissions targets and the policies and measures they have implemented, or plan to implement, to meet them. If carried out in full, these national plans would still result in a global warming trajectory of around 2.7°C by the end of the century – considerably adrift of the 2°C goal, let alone the 1.5°C aspiration.⁵ The agreement involves the review, every five years, of national plans, meaning that governments are expected to introduce new policies and measures, or tighten existing ones, to attempt to close this gap.

Policies that increase the cost of emitting GHGs, and which favour activities and technologies that reduce carbon emissions, will impact the revenues and earnings of a wide number of companies. Given that energy production accounts for the largest share (35 per cent) of global GHG emissions, regulation of the energy sector, such as through fuel taxes or performance standards, is also an important tool used by governments to reduce emissions. Changes to the cost of energy will impact the earnings of all companies.

As the successor to the 1997 Kyoto Protocol, the Paris Agreement is the first universal, legally binding international climate pact.

Investors are increasingly seeking to understand how existing and expected carbon and energy regulations are likely to affect the values of the assets they own, and how they might respond to risks associated with climate change more broadly. Regulators and policymakers are also responding. France and Sweden have introduced or are introducing carbon disclosure requirements for assets held by financial investors.^{6,7} The G20's Financial Stability Board, chaired by Bank of England Governor Mark Carney, has established a task-force to develop voluntary guidelines for corporate climate-related financial disclosure and a Green Finance Study Group (GFSG) to identify barriers to green finance. As Lead Knowledge Partner for the GFSG, CISL was asked to do a stock take of approaches to the incorporation of environmental risks into financial decision-making. This revealed an array of actors have started to develop tools to assess this risk. In February 2016, the European Systemic Risk Board recommended enhanced disclosure of corporate carbon intensity to allow financial firms' exposures to be stress tested.⁸ And, in March, both the Dutch and Swedish financial authorities announced findings of studies of the climate risk exposure of domestic financial institutions.⁹

1.2 Investors' responses to climate-related regulation

The growing physical effects of climate change, the increasing economic impacts of climate-related regulation, and the associated market and technological shifts towards a low-carbon society, mean that most investors now understand that their portfolios are exposed to climate risk.

They also recognise that climate risk varies between geographies, sectors and companies within those sectors, while the capacity and determination of companies to mitigate climate risk also varies.

In response, investors are requiring greater disclosure by companies of the climate risks they face, through, for example, reporting to CDP (formerly the Carbon Disclosure Project). Such disclosure has led to the development of strategies that favour companies with lower emissions than their peers, such as through the use of low-carbon indexes as developed by providers such as Standard & Poor's and MSCI.

Meanwhile, considerable work has been carried out to identify the quantum of climate risk facing investors, which in many cases may have little correlation to companies' current carbon footprint. Most of this research uses top-down economic modelling. For example, a recent study by investment consultancy Mercer estimated the potential impact of climate change on returns for portfolios, asset classes and industry sectors based on four climate change scenarios and four climate risk factors.¹⁰ Macro-economic analysis of this kind is helpful for strategic asset allocation; however, for investors' decision processes regarding stock selection, the short-term impacts of climate risks must become integrated into standard company valuation processes.

Investors are requiring greater disclosure by companies of the climate risks they face, through, for example, reporting to CDP.

1.3 Developing a bottom-up carbon and energy regulatory risk model

In 2014, ILG member Allianz Global Investors in partnership with Allianz Climate Solutions, The CO-Firm and WWF Germany undertook a pilot project to assess the short- and medium-term financial risk to investors from carbon and energy regulation. It examined the impact of carbon and energy regulation on company margins within the cement and dairy sectors in Germany, California and China's Guangdong Province. The pilot demonstrated that the financial impact can be substantial.

A review among ILG members, reinforced by the results of a CISL-led consultation for the G20's Green Finance Study Group, suggests that existing equity valuation models tend not to include a specific review of sources of energy consumption or carbon emissions (modelling depth, of course, depends on the sector under analysis and the investor itself). Often, carbon prices are flexed, but the regulatory regime is not captured in its entirety and the impact of regulation on a company's specific operations is not adequately assessed.

Following the successful conclusion of the pilot, the ILG extended the scope of the research together with the actors in the original pilot. The additional coverage includes the electric utility, oil refining and gas production sectors in Canada (Alberta), Spain and the United Kingdom, as well as the oil and gas sectors in Germany and California. These sectors and geographies were chosen given their carbon and energy emission intensities, their prominence in global equity indices and their interest to investors. As in the pilot, the model examines the impacts – at this stage, on a company's operations at the national level – of carbon and energy regulation on margins in 2020 under two scenarios, both before and after risk mitigation by the companies involved.

The objective is to help the investment industry price in potential future risks associated with energy and carbon regulation, and hence put pressure on industries and companies to pursue mitigating strategies (for example by upgrading technologies), including through engagement between investors and investee companies. The model provides outputs that can be integrated into existing valuation

techniques, and provides transparency on the measures required for companies to reduce the impacts on profitability associated with climate-related regulations. Traditional carbon reporting can thus not only be compared with an absolute emissions target, but progress can also be measured against the implementation of specific carbon/energy management measures at the company level.¹¹ Conversely, the tool could be of use to companies seeking to understand their ability to respond to energy and carbon regulation, and where they should prioritise their efforts.

The project is ambitious. This report is only a step forward in helping investors to identify the factors that differentiate future corporate performance (such as alternative technological or business strategies) and thus make better investment decisions. The long-term vision is that the model will cover any high-risk industry or company responses to regulatory pressure and various energy and carbon market/regulatory price scenarios and the implications of these for changes to margins. Ultimately, it would allow for investors (and their regulators) to stress test portfolios to assess overall levels of energy and carbon regulatory risk.

The main body of this report explains the model in detail, setting out its building blocks, scenarios and underlying assumptions. In section three, the report discusses the results so far, limits to the modelling, implications for implementation and next steps.

Part 2

The model explained

2.1 Model characteristics

The model quantifies regulatory risks at the company level.

It provides a quantified impact of energy and carbon regulations on the profit margins of each company, at the national level, in a specifiable set of scenarios. Providing a **quantified impact** is critical to allow for fundamental analysts to integrate the impact into their existing modelling. At this stage of the project, the focus is on direct emissions and energy use by companies, rather than modelling impacts along the entire value chain, although the tool lends itself to such modelling. The modelling is not intended to explicitly model stranded assets but rather to provide insights into the profitability of assets as the real economy transitions in line with the 2°C pathway, supported by changing regulation.

As the model differentiates companies based on their specific production processes, geographic footprint, and risk mitigation measures, it allows investors to determine companies' relative risk profiles. This **allows investors to pick stocks** based on their relative carbon and energy regulation risk.

It captures energy as well as carbon regulation. Of the three main climate change risk types, ie, physical, regulatory, and reputational, the model focuses on regulatory risk, which is considered by equity investors to be the most significant over the short to medium term (two to five years).¹² In addition to carbon pricing, governments also use energy policy to meet climate change objectives, through fuel taxes and renewables mandates and subsidies, for example. The impact mechanisms of energy regulations are different to those of carbon prices; thus looking at them separately is helpful.






The modelling is dynamic. That is, it captures the potential of individual companies for mitigating regulatory risk. It thus provides a risk assessment arising from the chosen regulatory scenario before any company action, and a risk assessment after each company has had the opportunity to react through, for example, investing in energy efficiency improvements or renewable energy capacity. Different elements of this modelling are already captured by existing research efforts or research streams, for example in environmental economics. However, the combination of these elements in itself and specifically for the use of equity investors is, to our knowledge, unique.

The model considers two scenarios. In the context of the work with the ILG, two regulatory scenarios for 2020 were defined – one based on plausible additional regulations, and one which considers a carbon price of €45/tCO₂, which the IPCC estimates is required to put the world on track to hold the average temperature rise to less than 2°C. This allows for the interpretation, communication and validation of results. In future versions of the model, various inputs, such as fuel and electricity prices, regulations, and timeframes, could be flexed for stress-testing purposes.

As the model differentiates companies based on their specific production processes, geographic footprint, and risk mitigation measures, it allows investors to determine companies' relative risk profiles. This allows investors to pick stocks based on their relative carbon and energy regulation risk.

Figure 2: Scenario assumptions

Transition Scenario

| Country | Assumptions | Source / rationale |
|--|---|---|
|  | <ul style="list-style-type: none"> • 31 % RE* • 20 EUR/tCO₂ • ROCs (8.9 bn EUR**)/ Contracts for difference (4.4 bn EUR**) • Feed-in-tariffs (3 bn EUR**) • Capacity market (1.3 bn EUR**) | <ul style="list-style-type: none"> • The UK Low Carbon Transition Plan • Member feedback, Carbon Tracker Initiative (CTI), Bloomberg • UK government • UK government • UK government |
|  | <ul style="list-style-type: none"> • 38 % RE* • 20 EUR/tCO₂ | <ul style="list-style-type: none"> • Spain renewable energy plan 2011 • Member feedback, CTI, Bloomberg |
|  | <ul style="list-style-type: none"> • 12 % RE* • "Compliance price" on emissions to increase to 19.75 EUR***; company level impact example 0.8 EUR ct./tCO₂ | <ul style="list-style-type: none"> • Projection of historical development • Bloomberg, Carbon Offset Research and Education (CORE) Initiative; Alberta Government |
|  | <ul style="list-style-type: none"> • Renewables levy (EEG) increase from 0,064 EUR/kWh to 0,074 EUR/kWh • Introduction of levies for capacity market and lignite reserve • No change in other taxes/levies (eg CHP, electricity and energy tax, offshore-levy) • 20 EUR/tCO₂ | <ul style="list-style-type: none"> • Agora Energiewende • German government |
|  | <ul style="list-style-type: none"> • 20 USD/tCO₂ • No change in other taxes/levies (eg energy resources surcharge, public benefit fund for renewables and efficiency) | <ul style="list-style-type: none"> • Member feedback, CTI, Bloomberg • Synapse Energy 2015 Carbon Dioxide Forecast |

€45 Carbon Price Scenario

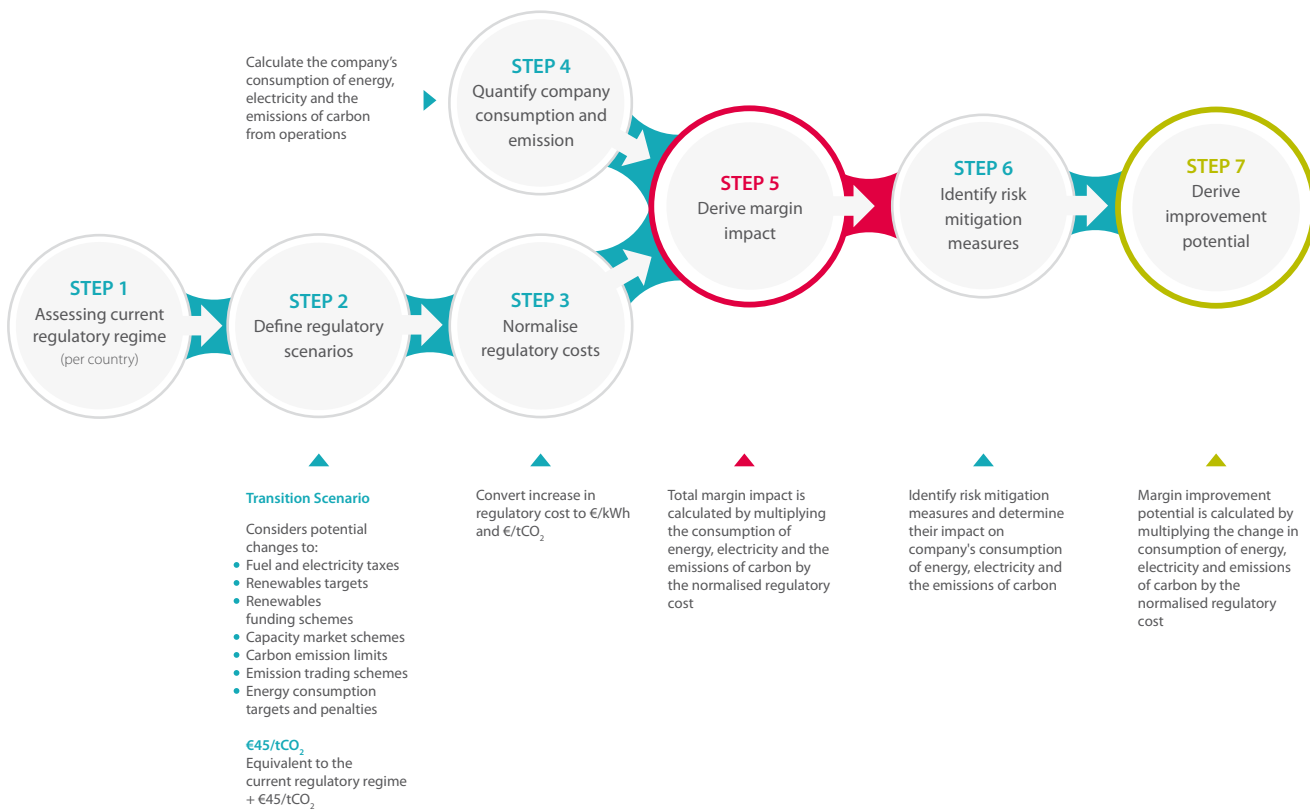
| Country | Assumptions | Source / rationale |
|---------|--|---|
| All | <ul style="list-style-type: none"> • 45 EUR/tCO₂, no free allowances, no additional regulation | <ul style="list-style-type: none"> • Member feedback, IPCC 430–480 ppm CO_{2eq} scenario |

* Renewables share in electricity generation ** Total system cost *** From 9.87 EUR/tCO₂; net costs per tCO₂ varies across sectors as compliance price represents upper limit for compliance for excess emissions

2.2 Model building blocks

The model comprises five steps (see Figure 3). The first step is an assessment of the current regulatory regime in the countries analysed, which forms the baseline. Scenarios are then defined for additional regulatory and carbon price assumptions. These regulatory costs are normalised (into euros per relevant unit of production), and then applied to company profitability for the operations in the countries in question (profitability before mitigation). Finally, the ability of companies to mitigate these costs is assessed (profitability after mitigation). These building blocks are set out in Annex 1.

Figure 3: Deriving margin impact



Part 3

Results and implications

3.1 Modelling results

Carbon and energy regulation can impact companies' margins.

Even under the Transition Scenario, the average national company margin at risk for utilities is significant – ranging from an increase in margin of 1.9 EUR ct./kWh in Spain to a reduction of -3.5 EUR ct./kWh in the UK. The reduction in the UK is particularly significant as the regulation would in effect potentially eliminate all the profit and result in the activity becoming a loss. Note that these results include regulation where costs can be passed through to customers. For the impact calculation that excludes regulation on utilities that will pass through increased costs to customers, see Annex 2.









Impacts on oil and gas companies are negligible under the Transition Scenario because of the limited additional regulations they are likely to face. However, risks become material for these sectors under the €45 Carbon Price Scenario. For oil refiners, the average margin at risk is around -1.2 EUR/bbl (15 per cent of profits). For gas companies, the sector margin impact can reach -5.5 EUR/km³ gas, in other words, 14 per cent of profitability. For Spain, however, there is no impact. The materiality of regulations would increase, for the gas sector, if all analysed installations were covered by the EU ETS, more than 35 per cent of its GHG emissions were regulated, and if the impact calculations were based on net margins and/or individual rather than average margins.

Companies' risk mitigation activities matter. In the €45 Carbon Price Scenario, oil refiners can mitigate impacts by approximately one third, from 15 per cent to 10 per cent. For electric utilities, mitigation activities can increase margins by more than 50 per cent in UK and Spain. Mitigation actions have limited effect in Canada, due to the structure of the market. For further details, see Figure 4. The impact of the regulation after mitigation activities have been implemented by the sector can be identified in Figure 4 under the column 'after efficiency'. The national-level results comprise the impact on all companies in the sector per country for oil refining and gas production. For utilities, they show the impact on the national MSCI-companies.

Even under the Transition Scenario, the average company margin at risk for utilities is significant – ranging from an increase in margin of 1.9 EUR ct./kWh in Spain to a reduction of -3.5 EUR ct./kWh in the UK.

3.1. Modelling results *continued*

Figure 4: Margin impact of regulation, before and after mitigation activities

| | |  | |  | |  | |  | |  | |
|---|----------------------------|---|---|---|---|---|---|---|---|---|--|
| | | Regulation impact | After mitigation | Regulation impact | After mitigation | Regulation impact | After mitigation | Regulation impact | After mitigation | Regulation impact | After mitigation |
|  | Oil refining | | | | | | | | | | |
| | Transition Scenario | -0.2 EUR/ bbl -3% | -0.1 EUR/ bbl -1% | -0.1 EUR/ bbl -1% | +0.2 EUR/ bbl +2% | 0.0 EUR/ bbl 0% | +0.1 EUR/ bbl +1% | -0.1 EUR/ bbl -1% | +0.5 EUR/ bbl +6% | 0.0 EUR/ bbl 0% | +0.2 EUR/ bbl +1% |
| | €45 carbon price | -1.2 EUR/ bbl -15% | -0.9 EUR/ bbl -11% | -1.1 EUR/ bbl -12% | -0.8 EUR/ bbl -9% | -1.4 EUR/ bbl -11% | -1.1 EUR/ bbl -9% | -1.2 EUR/ bbl -15% | -0.4 EUR/ bbl -5% | -1.4 EUR/ bbl -6% | -0.1 EUR/ bbl -4% |
|  | Gas production | | | | | | | | | | |
| | Transition Scenario | -0.6 EUR/ km ³ gas 0% | 0.0 EUR/ km ³ gas 0% | 0.0 EUR/ km ³ gas 0% | +0.4 EUR/ km ³ gas 0% | 0.0 EUR/ km ³ gas 0% | +0.2 EUR/ km ³ gas 0% | -0.4 EUR/ km ³ gas 0% | +0.1 EUR/ km ³ gas 0% | 0.0 EUR/ km ³ gas 0% | +0.3 EUR/ km ³ gas +1% |
| | €45 carbon price | -4.7 EUR/ km ³ gas -4% | -4.0 EUR/ km ³ gas -3% | 0.0 EUR/ km ³ gas 0% | +0.8 EUR/ km ³ gas +1% | -4.2 EUR/ km ³ gas -11% | -3.7 EUR/ km ³ gas -9% | -3.7 EUR/ km ³ gas -3% | -3.1 EUR/ km ³ gas -2% | -5.5 EUR/ km ³ gas -14% | -4.8 EUR/ km ³ gas -12% |
|  | Electric utilities | | | | | | | | | | |
| | Transition Scenario | -3.5 EUR/ ct./kWh -167% | +5.9 EUR/ ct./kWh +114% | +1.9 EUR/ ct./kWh +76% | +2.1 EUR/ ct./kWh +84% | -0.1 EUR/ ct./kWh -3% | -0.1 EUR/ ct./kWh -3% | | | | |
| | €45 carbon price | +0.2 EUR/ ct./kWh +10% | +1.2 EUR/ ct./kWh +57% | +1.6 EUR/ ct./kWh +64% | 1.8 EUR/ ct./kWh +72% | -2.5 EUR/ ct./kWh -64% | 2.5 EUR/ ct./kWh -64% | | | | |

Energy and carbon risk assessments can facilitate stock-picking. The analysis shows that risk profiles differ between companies. For oil, the analysis shows that margin impact can differ between refiners in the same country by up to 30 per cent due to refinery configuration. Further deviations can occur due to energy efficiency performance, etc. For gas, the analysis indicates significant variations if company-specific margins - instead of the average - were applied in the first place; further variations would be due to changes in the quality of gas, etc. For utilities, deviations in margin impact across the analysed companies in Spain range from -74 per cent to +279 per cent.

For further detail on the validation of the model and results, see Annex 3.

3.2 Limitations

The model can provide insights into the impact of carbon and energy regulation at the company level. Because the companies covered here are exposed to a regulatory environment outside of those five countries that were assessed in this phase, risk results are relevant only at a national level. Furthermore, the results are subject to a number of caveats based on the scope considered (only operations, and not emissions by value chains or product) and data availability. These mean that the actual impacts on margins are likely to be indicative rather than precise, and therefore it would not be appropriate to identify the individual companies analysed.

The most significant limitations to the results are a consequence of:

- **A focus on five countries of operation**
The modelling was carried out only on operations in five countries for oil and gas companies (Canada, Germany, Spain, the United Kingdom and the United States), and three countries for utilities (Canada, Spain and the United Kingdom). This means that the analysis does not capture the full global operations of the companies involved, nor therefore the full company exposure necessary for equity valuation purposes. Furthermore, it doesn't capture the potential for the companies involved to manage regulatory pressure by, for example, shifting production between jurisdictions.

- **A focus on operational emissions only**
In this project, the focus was on direct emissions and energy use by the companies (known as Scope 1 and Scope 2 emissions). It excluded emissions along the value chain and products (Scope 3 emissions). This decision was due to the scope of the project in assessing direct financial impacts and improvement potentials. However, the tool lends itself to modelling emissions along the value chain, as has been demonstrated in the pilot model.
- **Limited company disclosure**
Company-specific findings are to some extent subject to company disclosure. Overall, disclosure was better in the utilities sector, allowing for strongly differentiating results. For oil refining and gas production, the parameters disclosed depended on the company. Greater disclosure would enable the model to better differentiate the impact on profitability from regulation and mitigation.

Part 4

Next steps

The long-term vision of this work is to enable the investment decision-making process to incorporate upcoming regulation that aims to bring society closer to a 2°C climate scenario.

Equally, given the company-level insights the model provides, it has the potential to be used as an engagement tool, as it provides insights as to the extent to which company climate change commitments can be realistically translated into action. Further development and refinement of the tool is required but, once complete, it is envisaged that it could be used both to complement bottom-up financial analysis, as well as enable both investors and their regulators to stress test the stability of portfolios and financial systems.

Important directions for further research include modelling to cover the full operational footprint of the companies analysed. In the future, the model can also be expanded to other high-risk sectors, such as chemicals and transportation. We invite other investment firms, especially those with in-house financial analysis expertise, to become involved. Given the key role that sell-side institutions play in the industry's understanding of company value, we encourage them to participate, too.

The hope is that as more investors seek to understand the impact carbon and energy-related regulation may have on their investments, security brokers and information providers will respond with more compelling, complete and granular datasets and analysis to allow the investment industry to make more informed decision about the risk and return of their capital in a society in transition to a low-carbon economy.

Glossary

Adaptive/risk mitigation action

Any actions with a positive business case under the regulatory scenarios (ie a payback time of less than three years) under the conditions that the quality and quantity of the end product are not impacted and any technical measures are market proven.

Dynamic approach/modelling

In contrast to a static approach, the dynamic approach also takes the margin improvement potential of mitigation actions into account.

EU ETS

EU Emissions Trading System

IPCC

Intergovernmental Panel on Climate Change

Margin

Margin, or profitability, is the key impact figure identified in this project by the participating investors, against which the model determines the impact arising from regulatory changes before and after company risk mitigation. Margin impact can be integrated into financial model. For oil refining, the relevant margin is the spread between the refinery product revenues and the crude oil price. For deriving this margin, region-specific refining profitability indicators (regional crack spreads) can be applied. For gas production, the gross margin of a sample of 15 companies is applied; for utilities, the spread between generation cost and spot price is calculated, based on the specific merit order modelled (where existing) under the scenario assumptions.

Margin impact

Percentage impact on margin

Transition Scenario

This builds on the current legislative environment in each country and any changes to it that have been communicated – and are considered relevant – in election campaigns, are in the legislative process, or have already been agreed on and will come into effect by 2020. It incorporates political discussions, expert projections of historical regulatory trends, and outlook reports by institutions such as the government and Bloomberg.

Regulation: Climate and energy

Relevant regulations in the context of this project apply to

- Input-price effects to the production processes
 - CO₂
 - All relevant fuel types
 - Electricity
- Regulations changing output markets for electricity, ie:
 - Technology limits (for example, “no new coal”)
 - Renewables (share of renewables, price of renewable power, etc).

€45 Carbon Price Scenario

The €45 Carbon Price Scenario is defined by considering a carbon price of €45 to the current regulatory regime. Free allocations of allowances under the EU ETS are assumed to be withdrawn by 2020 to fulfil the 2°C requirement. The regulatory scope is assumed to remain unchanged and to be globally consistent – the current scope of the EU ETS was applied.

Annex 1: Model building blocks

The sections below explain in more detail the various model building blocks and related assumptions, covering regulations, the two scenarios, company risk mitigation options, sector-specific assumptions, and how the model avoids double-counting impacts with existing models.

The Regulations

Application of selected regulatory scenarios, based on country-specific analyses

The model comprises bottom-up modelling of national regulatory environments, as governments tend to apply different types of carbon and energy regulations and pursue different levels of ambition. Relevant regulations are those imposed on energy, electricity and carbon emissions that have the potential to change input prices, markets, and output prices, or which constitute technology barriers (see Figure 2). It builds on an assessment of the current regulatory regime, comprising, for example:

- Fuel and electricity taxes
- Renewables targets
- Renewables funding schemes
- Capacity market schemes
- Carbon emission limits
- Emissions trading schemes
- Energy consumption targets and penalties.

It excludes specific subsidy schemes (eg an investment grant for energy efficient lighting in Germany), but incorporates system-wide subsidies such as incentive programmes for renewables.

The scenarios

The model currently considers two scenarios: the Transition Scenario, based upon the effect on margins of planned and expected regulations, and a €45 Carbon Price Scenario which adds a carbon price in line with the 2°C pathway. The scenario assumptions are the driving force of changes to company margins. In fact, prices were kept constant as participating investors felt such an assumption was defensible and helped maintain the model's focus on regulatory impacts. The only exception is electricity prices, which change in line with the regulatory cost impact identified in the utility sector analysis for the UK, Spain and Canada (Alberta). The key assumptions for each scenario are detailed in Figure 2, 2.1 Model characteristics.¹³

The Transition Scenario

This uses the current legislative environment in each country as the starting point, and models the impacts of any changes to it that have been communicated, and are considered relevant, ie those that have been discussed in election campaigns, are progressing through the legislative process, or have already been agreed on and will come into effect by 2020. It incorporates political discussions, expert projections of historical regulatory trends, and outlook reports by institutions such as the respective governments, the IPCC and Bloomberg. These are validated and assessed by the participating investors and experts. Figure 2 illustrates the key changes to the current regulatory environment assumed for each geography.

In the UK, for example, renewable energy is expected to account for 31 per cent of power generation in 2020. This is in line with the UK Low Carbon Transition Plan. In order to fulfill this commitment while simultaneously maintaining system stability, the UK government has modified its subsidy regime (eg through the introduction of so-called Contracts for Difference and a phase-out of the Renewables Obligation). As a result, a sharp increase is expected in the costs of several energy market regulatory instruments. Additional costs stemming from the changes in UK market instruments have been included in the model.

Regarding the carbon costs trajectory in the EU ETS, a point-in-time carbon price of €20/tCO₂ was modelled, based on forecasts from Bloomberg and consultation with investors. No significant changes are expected regarding the current fuel regimes in any of the countries analysed.

The €45 Carbon Price Scenario adds a single parameter, ie, a carbon price of €45/tCO₂. All other regulations from the current regulatory regime are maintained. The €45 figure is the median carbon price assumption from the IPCC for 2020 for achieving a 2°C world.¹⁴ (Note that *Unhedgeable Risks*, published by CISL and the ILG in 2015, used a carbon price of \$100/tCO₂, or approximately €90, for a 2°C scenario.)

For ease of communication and validation, the €45 Carbon Price Scenario is defined to change only one parameter, carbon prices. Free allocations of allowances under the EU ETS are assumed to be withdrawn by 2020 to fulfil the 2°C requirement.¹⁵ We assume the regulatory scope to remain unchanged and to be globally consistent – the current scope of the EU ETS was applied. (This, for example, excludes at least 65 per cent of all emissions in the natural gas sector from its scope.)

Margin impact calculation

Providing an economic impact (margin impact)

The key value of the model is that it quantifies company-specific economic impact (at the national level). The impact figure identified in this project across the participating investors is the profit margin, against which the model determines the impact arising from regulatory changes before and after company risk mitigation. Once the model is applied to the entire geographic footprint of companies, the respective margin impacts can easily be integrated into existing valuation models. At this point in time, the profitability impact provides a first indicator of materiality, which needs to be weighted against the relevance of the geographies covered for each company's overall profitability.

To be useful to investors, the definition of profitability needs to be in line with common, sector-specific margins:

- For **oil refining**, this is defined as the spread between the refinery product revenues and the crude oil price. To derive this value, region-specific refining profitability indicators (the regional crack spread) can be applied.
- For **gas production**, the gross margin of a sample of 15 companies is applied.
- For **utilities**, the spread between generation cost and spot price is calculated, based on the power plant portfolio in 2020 and the specific merit order modelled (where existing - see box, Modelling the Merit Order and Market Dynamics, on page 21) under the scenario assumptions.¹⁶

To derive the margin impact, the regulatory impacts are condensed to key cost impacts (in euros). For example, the system costs for the Capacity Market in the UK are broken down to the cost burden per kWh produced. Based on the national aggregated operations and/or each individual company's operations, the resulting consumption of energy, electricity and the emissions of carbon are multiplied with the cost per regulated unit to arrive at the aggregated regulatory cost of the operations. The accumulated impact is calculated against the previous margin figure.

For utilities, changes to the volume of power produced, as a result of regulatory impacts, are also taken into account. This is because energy and carbon regulations not only change relative cost and technology choices, but can also change the quantity and the price of the product sold. The cost impact is therefore calculated for the 2020 power plant fleet based on current regulation and the regulatory scenario. The profitability impact assessment forms the final, key building block of the model.

Production technology configuration and risk mitigation measures

Interdependent modelling on the company- and sector-level

Current climate risk analyses for investors focus on the sector-level and do not typically provide granularity at the company-level.¹⁷ In contrast, the modelling approach applied here combines bottom-up and top-down approaches. For example, the electric utilities sector is modelled bottom-up, based on each plant that will potentially be operating in 2020, and validated with sector-level characteristics, such as the merit order resulting from the regulatory environment, demand, input costs and available plant technologies and capacities.¹⁸

Thus, the sector-level findings are confirmed based on the impact of each company, while the modelling enables the assessment of individual companies based on their specific plant technologies, fuel types and sizes. It also exposes the significant differences in the regulatory risk impact per company. For example, in 2020, Spain's power plant portfolio will comprise 51 per cent renewables by installed capacity and 12 per cent coal-fired power plants. The power plant mix of three of the top 10 electric utilities companies in Spain in 2020 differs substantially from the average: for example, none has more than two per cent coal-fired generation, while their share of renewable energy capacity is forecast to range from two per cent to 62 per cent.¹⁹ The three companies have very different portfolios and therefore will face differing margin impacts from energy and carbon regulation.

Annex 1: Model building blocks *continued*

Country-specific production processes, markets and prices

A fundamental assumption in the modelling is that regional differences in production technologies and markets are so profound that a global modelling of sector risks producing misleading results at the company level.²⁰ Major differences can be driven by regulation, by the sophistication of local sourcing markets, and by relative price differences. Take the cement sector, where the carbon footprint of primary and secondary fuels (such as waste tyres or biomass) differs substantially. The German cement sector sources around 60 per cent of its energy feedstock from secondary fuels, compared to nine per cent in California.²¹ In oil refining, the mix of crude oil used differs substantially between countries, based on availability and relative pricing. This affects both the absolute amount of energy used in refining as well as the relative carbon emissions. Similarly, fuel and electricity prices can differ markedly between countries and are differentiated in the model. Differences in energy costs applied can be found in Annex 4.

Company-specific risk mitigation activities (dynamic effects)

The model provides an integrated modelling of static regulatory risk and residual risk after companies have taken adaptive/risk mitigation actions. These actions comprise any measures with a positive business case under the regulatory scenarios (defined as a payback period of less than three years) under the conditions that the quality and quantity of the end product is not compromised and that the technology being applied is proven. Relevant mitigation measures that were tested for include:

- Technical measures
- Relocation
- (Partial) cost pass-through
- Changes in fuel mix
- Changes in heat/electricity generation capacity.

Carbon capture and storage was excluded as a possible mitigation measure due to limits to its cost-effective applicability by 2020.

As of today, companies may not have fully implemented all cost-effective technical energy or carbon measures available to them. This may be due to transaction costs, ie the cost of identifying, analysing and implementing the measures. New financial incentives, for example from regulations that change fuel or electricity costs, might provide the impetus to implement these measures while at the same time rendering new measures financially attractive. This modelling is based on selected statistical data, The CO-Firm's sector and production expertise, business case calculations, proprietary and non-proprietary third-party databases, studies

and papers, and feedback from company experts and financial analysts from ILG members on the degree to which measures are already implemented. As an example, around 30 technical efficiency measures were analysed in detail for oil refineries.

Sector-specific assumptions

Given that the model is intended to be complementary to existing valuation tools, it is important that they are aligned on some fundamental modelling assumptions to avoid, for example, inconsistencies and double-counting. Specific modelling decisions and assumptions are laid out in earlier sections of this report. Key sector-specific decisions and assumptions taken include the following:

Electric utilities

The country-specific merit order is modelled bottom-up, based on the individual power plants that are expected to be operating in 2020. Feedback on company-specific investment and divestment plans was integrated into the modelling. The underlying key assumptions and modelling boundaries are that:

- Electricity demand in each country is assumed to stay constant until 2020. Any major effects from electric mobility, for example, will only materialise after 2020.
- Generation efficiencies are modelled for each fuel type and technology.
- Pricing is based on the merit order for each country based on the expected power plant fleet and regulatory environment in 2020. The only exception is Canada (Alberta), as electricity trading takes place independently of merit order due to the particular structure of the province's electricity market. The merit order is modelled on an annual basis, not a point in time. Peak power plants for system stability are considered, including the associated revenue flows.
- Hedging contracts are not considered because regulations will impact them in the same manner as the spot market; the margin impact will merely be felt later.
- The potential to pass through additional regulatory costs depends on the extent to which all plants are subject to cost increases and on a power plant's position in the merit order.
- 2012 forms the base year, as this is the most recent year for which comprehensive data is available; however, for Spain, 2013 was chosen due to the impact of unusual weather conditions on hydro electricity generation in 2012.
- Fuel prices are assumed to be constant till 2020 (based on alignment with participating investors; validated with futures prices up to 2018).

- For each country, the potential remaining gap towards renewables generation targets for 2020 was identified. Each company is assumed to be able to build out as much of this gap as equals its current share in overall electricity generation.

Natural gas

The natural gas production process, including production, processing and transportation to the grid, is modelled based on country-specific energy consumption per process step. Any adjustments required on the company level were applied based on company feedback, where available. The underlying key assumptions and modelling boundaries are that:

- The exploration phase is not taken into account, due to its low share of energy use (around 3 per cent) and carbon emissions.
- Both associated and non-associated natural gas are modelled using the same approach.²²
- The country-specific production technologies were reflected in the modelling.
- Natural gas wells differ substantially even within countries. Statistically relevant data is used as the basis for energy consumption per country and the assessment of risk mitigation measures was validated with company feedback, where available.
- 2012 forms the base year.
- Fuel prices are assumed to stay constant till 2020 (based on alignment with analysts; validated with 2018 futures prices).

Oil refining

The diversity of refinery units is modelled by different refinery configurations, including the key energy consuming/carbon-emitting process steps. Each country is modelled bottom-up, based on each refinery and their configurations. The production technology configuration and energy consumption is adjusted according to company feedback (where available). The underlying key assumptions and modelling boundaries are that:

- 2012 as the base year. However, crude oil prices and margins are based on 2015 data, due to the dramatic price development from 2012 to 2015 and the expectation (as of mid-2015) that they will tend to stay low over the medium-term (to 2020).
- Other fuel prices are assumed to remain constant until 2020 (by agreement with participating investors and validated with 2018 futures prices).
- Every refinery is unique in its configuration and product portfolios can change by the minute. Thus, all refineries are modelled bottom-up assuming a constant product portfolio, based on a number of configuration clusters designed to match comparable energy use and carbon emissions.²³
- Country-specific margins (spreads) constitute the margin baseline.
- For the modelling, data sets such as the Lawrence Berkeley National Laboratory, A Barrel Full etc were used. Berkeley does not necessarily have any statistical significance in a strict academic sense.

Avoiding double-counting

The model calculates the impact on profitability resulting from regulation and ignores factors that would normally be considered within a traditional valuation model. This is to avoid double counting. For example, in the oil and gas sector, regional changes in crude oil supply, prices and regional capacities form part of existing valuation models and are thus not covered in the model. It instead accounts for the profitability impact based on a baseline margin arising from carbon and energy regulations which comes on top of any margin impact that might arise from other sector or market impacts. For example, the model builds on cost pass-through assumptions, but it doesn't make any assumptions on volume changes, given these would be an input of traditional valuation models. Climate-related regulation has, as of today, minimal effects on operational costs in the oil and gas sectors.

The electric utilities sector is different. Here, energy and carbon regulations not only change relative cost and technology choices, they can also change the quantity and price of the product sold (ie electricity). To capture this impact, the model builds on merit orders for running power plants (see Box below) that arise from the relative cost and other regulatory impacts that the power plant portfolio in a specific country will feature in 2020. Thus, the tool models market prices in the face of changing power plant portfolios and regulatory environments.

Modelling the Merit Order and Market Dynamics





The merit order is a ranking of the sources of electricity generation in a given power market, based on ascending marginal costs of production (ie excluding the capital expenditure involved). Typically, renewable energy plants with zero fuel costs, such as wind, solar and hydro, are first in the merit order.

The model creates a merit order for the UK and Spain for 2020 (in Alberta, price setting happens independent of a merit order). Factors influencing the marginal cost of electricity production, and thus the merit order, include the EU ETS and taxes or levies paid on input fuels.

Regulatory changes to the merit order impact not only market prices, but also the volume of electricity that is generated per fuel and technology type, ie the volume of electricity sold. Thus, on top of the merit order, the share of generation for each technology/fuel type over the course of an entire year was modelled. This provides a more accurate picture of how much electricity will actually be produced from each technology, and thus how market prices will form.

Annex 2: Utilities – no passthrough

Increase in cost due to regulation can be passed through to consumers for selected regulations, especially in the utility sector. Examples of such regulations are the Renewables Obligation and the Feed-in tariff scheme in the UK. The following table provides an overview of the impact of the scenarios if these types of regulation are excluded from the analysis.

| | |  | |  | |  | |
|--|----------------------------|---|----------------------------|---|---------------------------|---|---------------------------|
| | | Regulation impact | After efficiency | Regulation impact | After efficiency | Regulation impact | After efficiency |
| Electric utilities  | Transition Scenario | +1.7 EUR ct./ kWh +81% | +2.2 EUR ct./ kWh +105% | +2.1 EUR ct./ kWh +84% | +2.1 EUR ct./ kWh +84% | -0.1 EUR ct./ kWh -3% | -0.1 EUR ct./ kWh -3% |
| | €45 carbon price | +1.2 EUR ct./ kWh +57% | +1.2 EUR ct./ kWh +57% | +1.8 EUR ct./ kWh +72% | +1.8 EUR ct./ kWh +72% | -2.5 EUR ct./ kWh -64% | -2.5 EUR ct./ kWh -64% |

Annex 3: Validation

An integral part of extending the model was to ensure a high validity of the inputs.

The approach taken is presented in the following paragraphs along the key data sets:

- Cost
- Country-specific (sector/) company production processes/ market designs and company/sector risk mitigation measures
- Regulatory baselines and scenarios.

Any cost data (eg cost per fuel type per country) to be applied requires substantial cross-validation. Statistical data may or may not be available, it may or may not reflect the full cost to the company or it may not be consistent across sectors and company sizes. Critical country specificities need to be identified and implemented in the tool, as these not only impact the margin impact assessment, but also inform the assessment of economic viability of risk mitigation measures. The tool builds on a variety of statistical sources, in-house databases and company and country expert interviews. It systematically acknowledges differences in prices, for example between industry and households.

As indicated above, company production processes and available risk mitigation measures need to be analysed from a country-specific perspective to avoid any misleading results. The publicly available sector intelligence varies between sectors and countries. Building on databases of The CO-Firm, its experience in working with companies from various industry sectors across geographies, and more than 300 reports, statements and studies, the country-specific production processes and risk mitigation measures were defined. The process included rigorous crosschecks and validations across studies, across regions and countries, and across studies over time. In addition, the production processes and risk mitigation measures were

validated in 24 interviews with equity analysts, many of them from the ILG membership, and eight interviews with company or sector experts. Any data gaps were closed in the interviews with their sector expertise and proprietary third-party data sets, and key assumptions were agreed upon. An academic review was carried out by an environmental economist at the Energy Policy Research Group at the University of Cambridge.

Another integral part of the validation process was direct engagement with companies regarding the results. Companies were asked to assess their performance on a small set of critical production process characteristics, depending on the sector, and/or key adaptive capacity measures. The results supported the validation of the modelling assumptions as well as the modelling results.

To develop the regulatory baseline for each country, the regulatory environment was mapped, interpreted and assessed by its cost impact. Few cumulative data sets on regulatory environments are available, and none cover the scope of regulation captured in this analysis. Based on its experience in assessing regulatory impact for companies, The CO-Firm leveraged in-house databases and a variety of national and regional sources to develop comprehensive regulatory baselines for each country. In a similar process, using press releases, reports and studies and expert interviews, the Transition Scenario was developed. Both the regulatory baseline and the Transition Scenario were validated with the participating investors (including their financial and sustainability analysts), the ILG Advisory Board and a broad set of external experts.

Annex 4: Non-regulatory energy costs applied

Energy prices before taxes and levies are used in the model. Prices of the energy sold to industry and energy sold for electricity generation are differentiated as is the case in the market.

Margins for gas production are calculated with the spot market price due to the sector's dependency on spot market.

| Indicator | Spain | | | UK | | | Canada - Province Alberta | | |
|-----------------------|---|---|-------------------------------|---|---|-------------------------------|---|---|-------------------------------|
| | Pure energy costs w/o regulation electricity generation | Pure energy costs w/o regulation for industry | Spot market price as of today | Pure energy costs w/o regulation electricity generation | Pure energy costs w/o regulation for industry | Spot market price as of today | Pure energy costs w/o regulation electricity generation | Pure energy costs w/o regulation for industry | Spot market price as of today |
| | EUR/kWh | EUR/kWh | EUR/kWh | EUR/kWh | EUR/kWh | EUR/kWh | EUR/kWh | EUR/kWh | EUR/kWh |
| Electricity | | 0,1153 | | | 0,1012 | | | 0,0590 | |
| Hard coal | 0,0121 | 0,0305 | | | | | | | |
| Bituminous coal | 0,0110 | 0,0276 | | 0,0118 | | | | | |
| Subbituminous coal | 0,0121 | | | | | | 0,0050 | | |
| Petroleum coke | | | | | | | | | |
| Heavy fuel oil | 0,0526 | 0,0526 | | 0,0447 | | | | | |
| Light fuel oil | | | | 0,0178 | | | | | |
| Natural gas | 0,0299 | 0,0342 | 0,0284 | 0,0263 | 0,0291 | 0,0250 | 0,0102 | 0,0088 | 0,0076 |
| Liquified natural gas | 0,0269 | | | | | | | | |
| Nuclear | 0,0047 | | | 0,0047 | | | | | |

| Indicator | Germany | | | US - California | | |
|-----------------------|---|---|-------------------------------|---|---|-------------------------------|
| | Pure energy costs w/o regulation electricity generation | Pure energy costs w/o regulation for industry | Spot market price as of today | Pure energy costs w/o regulation electricity generation | Pure energy costs w/o regulation for industry | Spot market price as of today |
| | EUR/kWh | EUR/kWh | EUR/kWh | EUR/kWh | EUR/kWh | EUR/kWh |
| Electricity | | 0,0778 | | | 0,0607 | |
| Hard coal | 0,0050 | | | 0,0081 | 0,0121 | |
| Bituminous coal | | | | | | |
| Subbituminous coal | | | | | | |
| Petroleum coke | | | | | | |
| Heavy fuel oil | | | | 0,0591 | 0,0483 | |
| Light fuel oil | | | | | | |
| Natural gas | 0,0307 | 0,0307 | 0,0250 | 0,0106 | 0,0117 | 0,0076 |
| Liquified natural gas | | | | | | |
| Nuclear | | | | | | |

Consolidating three years of leadership

The Investment Leaders Group (ILG) is three years old. Over that time we have taken a fresh look at some of the most interesting challenges and opportunities thrown up by investment. We'd like to share some of the highlights of this journey with you.

The group started by clarifying the purpose of its work in the 2014 report, *The Value of Responsible Investment*. This explored the ethical, financial and economic cases behind responsible investment, concluding that it is not only consistent with fiduciary responsibilities but, done well, can improve long-term returns while reducing systemic risks.

We then turned our attention to *fiduciary law*, particularly in the United States where pension fund trustees and beneficiaries have struggled to relate social and environmental issues to investment decisions. A presentation was published to explain why these are legitimate concerns of fiduciaries. It was gratifying to see the US Department of Labor concur with this position in recent guidance.

Three areas were then selected for more work:

- **Investment impact.** While the financial performance of funds is readily accessible, their social and environmental impacts remain largely opaque to the public and the industry itself. To change that, we have developed a framework (*In search of impact*) to help investors measure and communicate their contribution to sustainable development.



Philippe Zaouati

CEO, Mirova and Chair,
Investment Leaders Group (ILG)

- **Investment mandates.** In our report, *Taking the long view*, we identify the characteristics of mandates that encourage long-term, sustainable investment management. By adopting this guidance, investors strengthen their ability to make capital work in the long-term interest of beneficiaries and society.
- **Risk and opportunity.** While many investors recognise social and environmental risks in portfolios, they lack tools to integrate them into existing financial models. Climate change poses a clear and present risk (and opportunity) to investments and was therefore our starting point. This report guides the industry in assessing the impact of carbon-related regulation on asset profitability, while our research, *Unhedgeable Risk*, published in 2015, examines the effects of climate-related shifts in market sentiment on portfolio value.

It would not be an overstatement to say that if the proposals in these reports were implemented, the investment industry would evolve into a force for positive social and environmental impact in the world, a true partnership with our clients and beneficiaries.

This would be some accomplishment. We hope you will join us on this journey.



Dr Jake Reynolds

Director, Sustainable Economy,
Cambridge Institute for Sustainability
Leadership (CISL)

References and notes

- ¹ For each sector, the margin of most relevance to financial analysts was identified.
- ² These numbers include charges which are assumed to be passed through to consumers.
- ³ IPCC. (2014). Summary for Policymakers. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.
- ⁴ Entry into force requires at least 55 countries, accounting for at least 55 per cent of global emissions, to ratify the Paris Agreement.
- ⁵ Climate Action Tracker (2016, December 16), 'Climate pledges will bring 2.7°C of warming, potential for more action'. Press release. Retrieved from <http://climateactiontracker.org/news/253/Climate-pledges-will-bring-2.7C-of-warming-potential-for-more-action.html>
- ⁶ Rust, S. (2016, February 1). France aims high with first-ever investor climate-reporting law, Investment & Pensions Europe. Retrieved from www.ipe.com
- ⁷ Mooney, A. (2015, November 22). Sweden: climate impact of investments must be disclosed, Financial Times. Retrieved from www.ft.com
- ⁸ European Systemic Risk Board. (2016, February). Too late, too sudden: Transition to a low-carbon economy and systemic risk. Retrieved from https://www.esrb.europa.eu/pub/pdf/asc/Reports_ASC_6_1602.pdf
- ⁹ Wagner, J. (2016, March 10), Dutch central bank latest regulator to tackle issue of climate risk in the financial sector, Responsible Investor. Retrieved from <https://www.responsible-investor.com/>
- ¹⁰ Mercer. (2015), Investing in a Time of Climate Change. Retrieved from www.mercer.com/content/dam/mercer/attachments/global/investments/mercer-climate-change-report-2015.pdf
- ¹¹ See, for example, Science Based Targets under <http://sciencebasedtargets.org/>
- ¹² There are also other classifications of climate change risks possible. The Bank of England for example, characterises climate change-related risks as physical, litigation and transition. The model would integrate into the transition risk category.
- ¹³ The model would allow for integrating commodity price changes into the scenarios.
- ¹⁴ IPCC. (2014) Mitigation of Climate Change, Working Group 3 contribution to the Fifth Assessment Report of the IPCC 2014. Retrieved from https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_full.pdf
- ¹⁵ Although auctioning is the default method for allocating emission allowances to companies participating in the EU ETS, manufacturing industry will continue to receive a share of allowances for free until 2020 and beyond. Free allocation is carried out on the basis of benchmarks of GHG emissions performance. Installations that meet the benchmarks, and are thus among the most efficient, will in principle receive all the allowances they need. Those that do not reach the benchmarks will receive fewer allowances. The power sector, meanwhile, is required to buy all its needed allowances, with some exceptions for installations in the Eastern European member states and Cyprus, if they fulfill certain conditions.
- ¹⁶ Including fuel cost, carbon cost, climate and energy regulatory costs aiming on fuels; excluding CAPEX and maintenance.
- ¹⁷ A notable exception is the "Capex Tracker" from Carbon Tracker, building on the work on Stranded Assets. www.carbontracker.org/report/capex-tracker-a-lead-indicator-of-global-warming. Also, the 2° Investing Initiative is starting to work on the company level.
- ¹⁸ The analyses build on proprietary and non-proprietary third-party databases, own datasets, a large set of external reports, analyses and papers, own validations, governmental and press outlooks, company feedback, among others.
- ¹⁹ Power plant mix is by installed capacity as of 2012
- ²⁰ Examples of global modeling include the Science Based Targets initiative by CDP, the UN Global Compact, the World Resources Institute and WWF.
- ²¹ Own analysis; Verein Deutscher Zementwerke (VDZ), Umweltdaten der deutschen Zementindustrie (2011); Berkeley Lab, Potential Energy Savings and CO₂ Emissions Reduction of China's Cement Industry (2012).
- ²² Associated gas is gas produced as a byproduct of the production of crude oil; non-associated gas reserves are developed primarily to produce natural gas.
- ²³ The clusters were built similar to the approach taken by the International Energy Agency (IEA, The European Refinery Industry under the EU Emissions Trading Scheme, 2005). Information on single refinery configurations were derived based on company information and from the database "A Barrel Full" (<http://abarrelfull.wikidot.com>). The key refinery processes reflect around 85 per cent of total energy consumption.

